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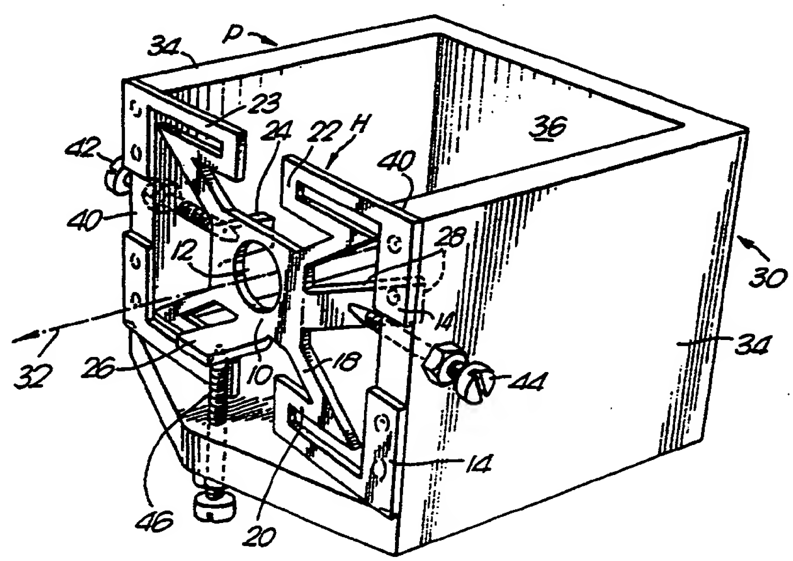

(57) Abstract

A miniature lens holder comprises a lens frame (10) supported on mounting plates (14) by means of flexible support members (16). The lens frame (10) is formed with alignment tags, (24, 26) extending normally thereto. These may be engaged by alignment screws (42, 44) to adjust the position of the lens in the X and Y directions. A further tag (28) is bent at an intermediate angle out of the plane of the frame (10). A further screw (46) bears against the face of the tag (28) to move it in the Z direction, thereby to focus the lens with respect to a beam of laser light. The support members (16) are designed to flex to accommodate the relative movement between the lens frame (10) and the mounting plates (14).

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OPTICAL COMPONENT HOLDER

This invention relates to an adjustable optical compon nt holder.

In electro-optic components there is often an interfac coupling between, for example, a semi-conductor laser and an optical fibre or some other optical component. In general, the laser has a wide angle, far field beam divergence (up to 30° full width half maximum). The laser beam, therefore, has to be focused for efficient coupling. Coupling is typically achieved using any of a number of different lens types, such as lensed fibres, graded index lenses, sphere lenses and aspheric lenses, such as CD player lenses. The most popular lens arrangement used in coupling between a laser and a fibr is the lensed fibre as it does not require a separate holder and adjustment mechanism for the lens. However, for other applications, such as beam collimation, the lensed fibre is not suitable, and another of the lens types has to be used.

In micro-optic applications the size of the other lens types is compromised by the need for a lens holder and manipulation system. Thus, in the past, a compromise has had to be reached between size, positioning accuracy and cost.

In particular, the field of sub-miniature long external cavity lasers requires the precise collimation of the laser output to a diffraction grating. Current lens assemblies of this type rely on critically machined parts and precision alignment. These factors make up a substantial part of th overall cost of a device (about 30%). Thus, although the long external cavity laser has attractive features for systems applications, its use in these areas has been limited by its relatively high cost.

The present invention provide an optical component holder comprising a component frame for holding an optical component, mounting means for mounting the holder in a housing, and fl xible members for supporting the component frame on the mounting means, wherein the component frame is provided with at least one tag projecting therefrom, the or each tag being

engageable to move the component frame relative to the mounting means ther by to position the component frame in each of the thr e orthogonal directions with r spect to the mounting means by flexure of the flexible members, and wherein the component frame and the flexible members lie in a common plane, and the or each tag extends at an angle to said plan .

In a preferred embodiment, there are first, second and third tags, the first and second tags extending substantially at right-angles to the plane of the component frame in opposite directions, and the third tag projecting at an acute angle to the plane of the component frame. Advantageously, the third tag extends at an angle of 30° to the plane of the component frame.

Preferably, each flexible member comprises a first joint having a first portion connected to a second portion, the first portion extending in a first direction, and the second portion extending in a second direction. The first portion of each first joint may be disposed at an angle of between 30° and 45° to the associated second portion, and each flexibl member may further comprise a second joint having third and fourth portions connecting the first joint of that flexible member to the mounting means. The third portion of each flexible member may be disposed at an angle of 90° to the associated fourth portion.

Preferably, the mounting means is constituted by mounting plates to which the flexible members are attached, and by which the holder may be secured to a device.

Preferably, the holder is stamped or cut from a flat plate. It may be made of either a metal, (such as steel or Kovar) or a plastics material, or of any other suitably flexible material. The flexibility of the flexible members may involve elasticity or simply the ability to undergo plastic deformation without fracture.

The invention also provides an electro-optic assembly comprising an electro-optic device mounted in a housing and a component holder as defined above, wherein an optical component is mounted in the component fram , and wherein the housing is provided with positioning means for adjusting the

position of the component frame th reby to align the optical compon nt with th electro-optic device.

Advantageously, the positioning means is constituted by screw means which bear on the component frame to adjust the position thereof. Preferably, the screw means bear on the tag(s) to move the frame relative to the mounting means. Conveniently, there are first, second and third screws, each of which extends parallel to the plane of component frame, th first and second tags being engaged separately by the first and second screws to move the component frame parallel to th plane of the holder, and the third tag being engaged by th third screw to move the component frame in a direction transverse to the plane of the holder.

A lens holder constructed in accordance with the invention will now be described in detail, by way of exampl , with reference to the accompanying drawings in which:

Figure 1 is a plan view of the lens holder;

Figure 2 is a side elevation of the lens holder of Figur 1;

Figure 3 is a perspective view of the lens holder mount d in a lens positioner; and

Figure 4 is a schematic representation of the adjustment mechanism of the lens positioner of Figure 3.

Referring to the drawings, Figures 1 and 2 show a lens holder indicated generally by the reference H. The holder H is constituted by a flat lens frame 10 in the form of a 4mm x 3mm rectangular steel plate, having a central circular hole 12 in which a lens (not shown) is received. The lens, which is preferably a spherical lens, has a diameter of 2mm. The holder H is cut from a flat sheet of 500 micrometre thick steel using an industrial laser cutter. After cutting, the device is a 2-dimensional, flat item, as depicted in Figure 1.

The frame 10 is supported on four mounting plates 14 by four suspension arms 16. The mounting plates 14 are positioned adjacent to the corners of the frame 10, and are disposed generally parallel to the shorter sid s of the frame. Each suspension arm 16 comprises first and second portions 18

and 20, each of which is about 2mm in length. Each first portion 18 extends diagonally outwardly from a r spective corner of the frame 10, and is connected to the associated second portion 20. Each second portion 20 extends at an angle of 45° to the associated first portion 18, and is disposed parallel to the longer sides of the frame 10. The connect d first and second portions 18 and 20 of each pair form a flexible joint which is connected to a respective one of the mounting plates 14 by a further flexible L-shaped limb formed by third and fourth portions 22 and 23 of that suspension arm 16. The third portions 22 are each 1mm in length, and th fourth portions 23 are each 3mm in length. Each of the suspension arm portions 18, 20, 22 and 23 constitutes a region of flexure which allows the lens frame 10 to be moved relative to the mounting plates 14.

The lens holder H exploits the flexibility of the metal and in particular the configuration of the suspension arms 16 having members capable of flexure in mutually normal directions parallel to the plane of the flat frame 10. Th portions 18, 20, 22 and 23 of the suspension arms 16 are also capable of flexure in planes normal to the plane of the fram 10 in order to focus the lens.

The holder H is formed with first, second and third alignment tags 24, 26 and 28. The first alignment tag 24 extends about 1.5mm at right-angles to the lower (as shown in Figure 1) longer side of the frame 10. The second alignm nt tag 26 extends about 1.5mm at right-angles to the lower (as shown in Figure 1) longer side of the frame 10. This second tag 26 extends to the outer edge of the holder as defined by the fourth portions 23 of the lower two suspensions arms 16. The third tag 28 extends about 3mm at right-angles to the right-hand (as shown in Figure 1) shorter side of the frame 10. This third tag 28 extends to the outer edge of the hold r H as defined by the adjacent mounting plates 14.

Figure 3 shows th- holder mounted in a lens positioner P. In order to permit the lens positioner P to adjust the position of a lens mounted in the holder H, the tags 24, 26 and 28 are bent out of the plane of the frame 10. Thus as

shown in Figure 2, the tags 24 and 28 ar b nt to on sid of the fram , whil the tag 26 is bent to the other side of th frame. As best shown in Figure 3, the first alignment tag 24 extends at right-angles to the plane of the frame 10 and away from the viewer. The second alignment tag 26 extends at right-angles to the frame 10 in the opposite direction to th first alignment tag 24. The third alignment 28 is bent, at an angle of about 30°, out of the plane of the frame 10 in the same sense as the first alignment tag 24. The angle through which the third tag 28 is bent is not critical, provided the inclined surface of the tag can be engaged (as described below) to move the frame 10.

The positioner P (see Figure 3) comprises a housing 30 in which would normally be mounted, for example, a laser. The laser is not shown in Figure 3 for the sake of clarity, but the arrow 32 denotes a notional laser beam to which the l ns 12 is to be aligned, and by which the beam is to be focus d. The housing 30 has two side walls 34, a back wall 36 and a base 38. The mounting plates 14 of the lens holder H are spot-welded to end faces 40 of the side walls 34 remote from the back wall 36. Thus, the lens frame 10 is suspended in line with the source of the laser beam 32.

Finely-threaded, co-axial X-alignment and focusing screws 42 and 44, respectively, extend through aligned threaded holes in opposite side walls 34 of the housing 30. A Y-alignment screw 46 extends at right-angles thereto, through a threaded hole in the base 38. The X- and Y-alignment screws 42 and 46 respectively engage the alignment tags 24 and 26. By rotating the screws 42 and 46, the horizontal and vertical adjustment of the lens frame 10 can be effected by causing the various portions 18, 20, 22 and 23 of the suspension arms 16 to flex.

Focusing is achieved by adjustment of the focusing screw 44 which engages the face of the tag 28. The force F exerted by tightening the focusing screw 44 onto the focusing tag 28 can be resolved into two components, $F\sin\theta$ and $F\cos\theta$ (see Figure 4). Th component $F\cos\theta$ tends to move the frame 10 in the direction of X alignment, but this is prev nted by the X-alignment screw 42 which abuts the X-alignment tag 24. The

compon nt Fsinθ mov s the fram substantially along the Z-axis to focus the lens mounted therein. The actual movement in relation to the Z-axis is discussed below.

The positioner P is designed so that the laser is bonded in position in the housing 30 before the lens holder H is added. When the lens holder H is positioned, it is off-s t towards the X- and Y-alignment screws 42 and 46, and away from the focusing screw 44 by about 100 micrometres. From this position, the screws 42, 44 and 46 can be adjusted to align the lens, and then to focus it in accordance with the positioning of the laser and the path its beam 32 takes. It is important to achieve X- and Y-alignment before the lens is focused. This is to ensure that the movement of the focusing screw 44 has minimal effect on the X / Y position of the frame 10 abutting the X and Y alignment screws 42 and 46. Once th required adjustment of the lens has been carried out, the screws 42, 44 and 46 are fixed by locking nuts, soldering, welding or any other appropriate means.

It will be appreciated that the adjustment of one of the focusing screw 44 and the X-alignment screw 42 may disturb th other. However, by adjusting the X-alignment screw 42 first, any further movement in the X direction is prevented. As the focusing screw 44 is adjusted, and bears on the tag 28, it tends to rotate the frame 10 slightly about a notional axis substantially parallel to the Y direction. As indicat d above, the degree of adjustment required is usually less than 100 micrometres for any of the screws 42, 44 or 46. Thus, the amount of rotation is tolerable in most cases, particularly where the lens is spherical. In summary, the adjustments ar not wholly independent, but the amount of influence one has on the other is negligible.

The miniature lens holder described above allows precision adjustment along three axes of movement for an electro-optic component, such as a lens in an electro-optic assembly. The holder is of a simple and c mpact construction, which helps considerably in reducing the size and cost of a packaged electro-optic component.

CLAIMS

1. An optical component holder comprising a component frame for holding an optical component, mounting means for mounting the holder in a housing, and flexible members for supporting the component frame on the mounting means, wherein the component frame is provided with at least one tag projecting therefrom, the or each tag being engageable to move the component frame relative to the mounting means thereby to position the component frame in each of the three orthogonal directions with respect to the mounting means by flexure of the flexible members, and wherein the component frame and the flexible members lie in a common plane, and the or each tag extends at an angle to said plane.

2. A holder as claimed in Claim 1, wherein there are first, second and third tags, the first and second tags extending substantially at right-angles to the plane of the component frame in opposite directions, and the third tag projecting at an acute angle to the plane of the component frame.

3. A holder as claimed in claim 2, wherein the third tag extends at an angle of 30° to the plane of the component frame.

4. A holder as claimed in any of Claims 1 to 3, wherein each flexible member comprises a first joint having a first portion connected to a second portion, the first portion extending in a first direction, and the second portion extending in a second direction.

5. A holder as claimed in claim 4, wherein the first portion of each first joint is disposed at an angle of between 30° and 45° to the associated second portion.

6. A holder as claimed in claim 4 or claim 5, wh rein each fl xible member further comprises a second joint having third

and fourth portions connecting the first joint of that flexible member to the mounting means.

7. A holder as claimed in claim 6, wherein the third portion of each flexible member is disposed at an angle of 90° to the associated fourth portion.

8. A holder as claimed in any one of claims 1 to 7, wherein the mounting means is constituted by mounting plates to which the flexible members are attached.

9. A holder as claimed in any of Claims 1 to 8, wherein the holder is stamped or cut from a flat plate.

10. A holder as claimed in any of Claims 1 to 9, wherein the holder is made of a metal or a plastics material.

11. An electro-optic assembly comprising an electro-optic device mounted in a housing and a component holder as claim d in any one of Claims 1 to 10, wherein an optical component is mounted in the component frame, and wherein the housing is provided with positioning means for adjusting the position of the component frame thereby to align the optical component with the electro-optic device.

12. An assembly as claimed in Claim 11, wherein the positioning means is constituted by screw means which bear on the component frame to adjust the position thereof.

13. An assembly as claimed in Claim 12, wherein the screw means bear on the tag(s) to move the frame relative to th mounting means.

14. An assembly as claimed in Claim 13 when appendant to claim 2, wherein there are first, second and third screws, each of which ext nds parallel to the plane of component fram , the first and second tags being engaged separately by the first and s cond screws to move the component frame

parallel to the plane of the hold r, and th third tag b ing engag d by the third screw to move the component frame in a direction transverse to the plane of the holder.

Fig.1.

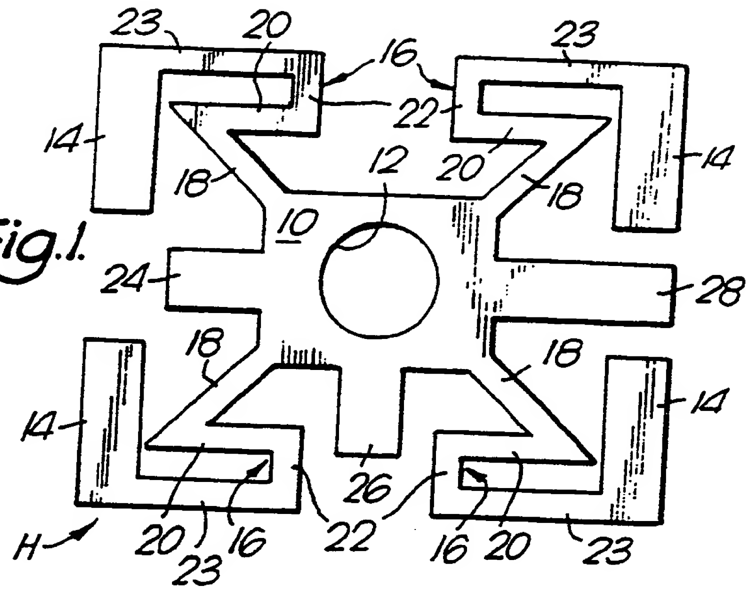


Fig.2.

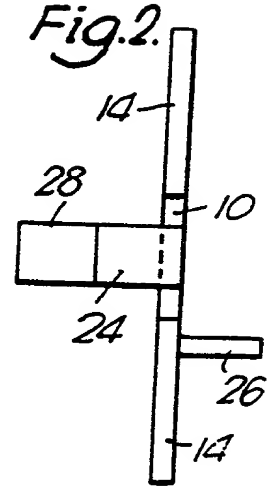


Fig.3.

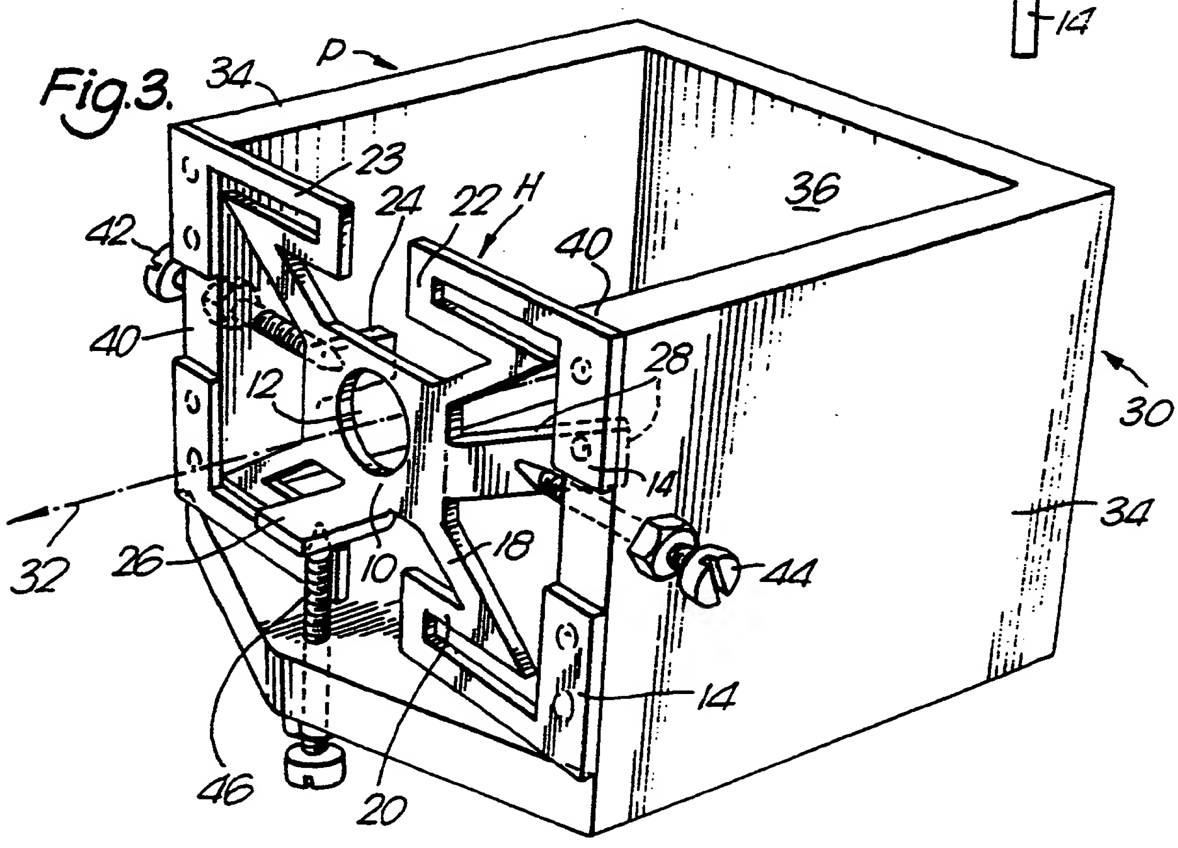
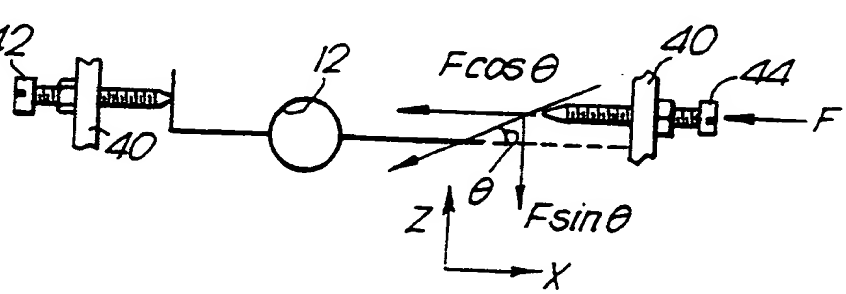


Fig.4.



INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/01301

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 G02B6/42 ; G02B7/02

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	G02B ; B23Q

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	US,A,4 691 586 (LEIJENHORST ET AL) 8 September 1987 see column 1, line 1 - line 14 see column 4, line 48 - line 55 see column 11, line 46 - line 68 see column 12, line 1 - line 2 see figure 4 ---	1,4, 6-12,14
A	US,A,4 773 727 (LE PIVERT ET AL) 27 September 1988 see column 1, line 6 - line 12 see column 2, line 64 - line 68 see column 3, line 1 - line 33 see figures 1-5 ---	1,4,11, 13

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° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
31 OCTOBER 1991	07 NOV 1991
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	WARD S.M. Seamus Ward.

3

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	EP,A,0 168 820 (SIEMENS) 22 January 1986 see page 2, line 29 - line 32 see page 3, line 1 - line 2 see page 3, line 21 - line 35 see page 4 see page 5, line 1 - line 7 see figures 1,2 ---	1,8-14
A	DE,A,3 217 298 (SIEMENS) 10 November 1983 see page 10 - page 12 see page 13, line 1 - line 11 see claim 18 see figures 1-3 ---	1,4,6,8, 10-12,14
A	EP,A,0 100 781 (AEG TELEFUNKEN) 22 February 1984 see page 3 see page 4, line 1 - line 3 see figure ---	1,4,6-8, 11,12,14
A	US,A,4 793 688 (AIKI ET AL) 27 December 1988 see column 4, line 5 - line 39 see figures 1,2,7,8 ---	1,8,10, 11
A	EP,A,0 348 845 (NEC) 3 January 1990 see column 3, line 13 - line 58 see column 4 see column 5, line 1 - line 14 see figures 3-6 ---	1,4,10

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9101301 SA 49913

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 31/10/91
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4691586	08-09-87	NL-A-	8500615	01-10-86
		EP-A,B	0193991	10-09-86
		JP-C-	1518821	29-09-89
		JP-A-	61223709	04-10-86
		JP-B-	63062721	05-12-88
US-A-4773727	27-09-88	FR-A-	2606890	20-05-88
		EP-A-	0269925	08-06-88
		JP-A-	64000505	05-01-89
EP-A-0168820	22-01-86	JP-A-	61036710	21-02-86
DE-A-3217298	10-11-83	None		
EP-A-0100781	22-02-84	CA-A-	1208950	05-08-86
		US-A-	4491294	01-01-85
US-A-4793688	27-12-88	JP-A-	62276519	01-12-87
EP-A-0348845	03-01-90	JP-A-	1315035	20-12-89

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Fig.1.

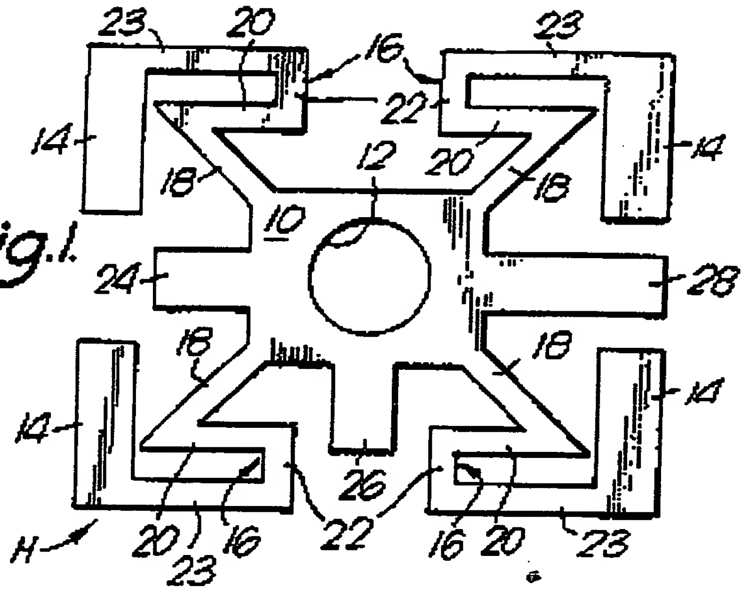

Fig.2.

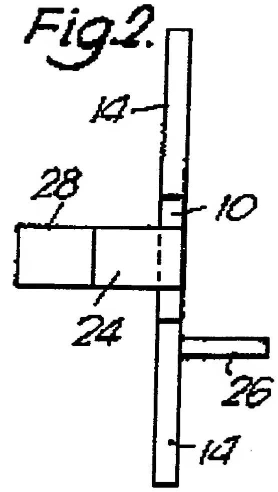

Fig.3.

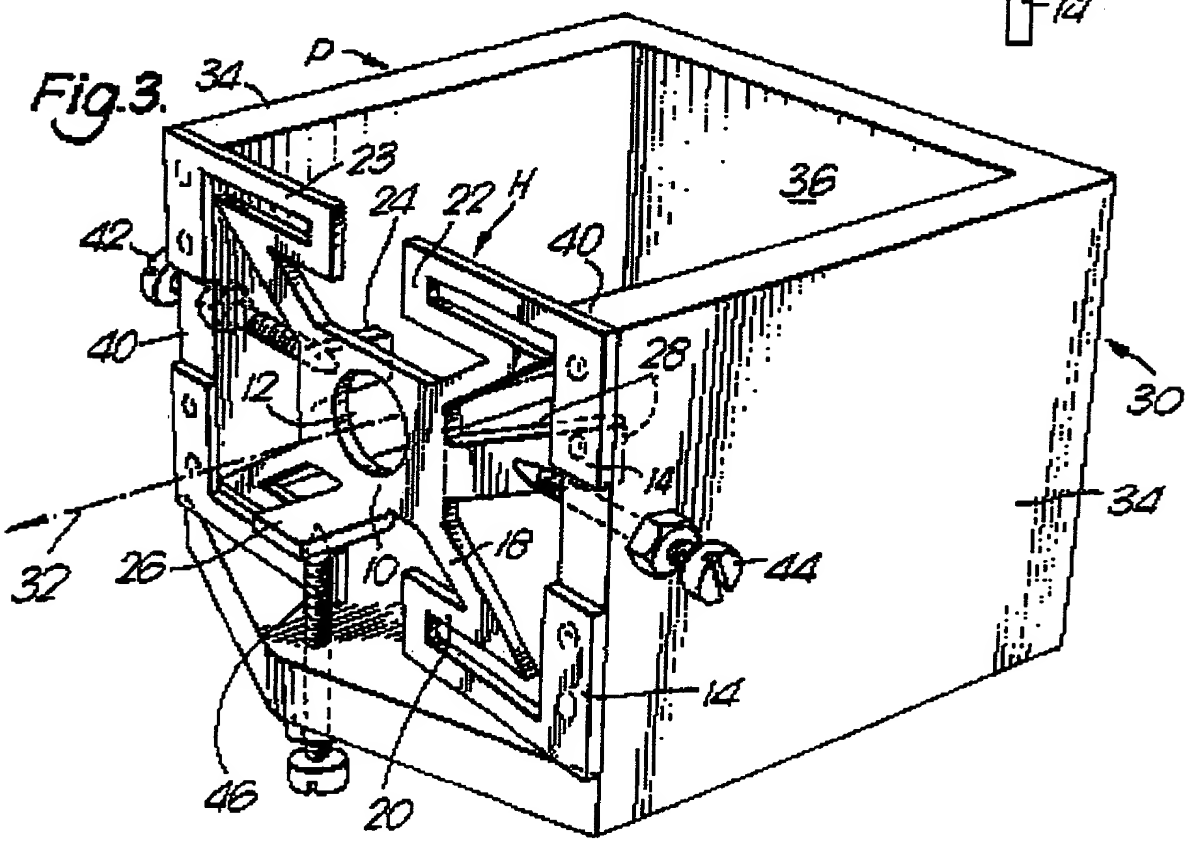

Fig.4.